Assessment of the Potential Costs and Energy Impacts of Spill Prevention, Control, and Countermeasure Requirements for Wind Energy

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By

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Wind Energy

1. Sector Description

Wind power is today's most rapidly growing renewable power source. In the United States, new wind farms were the second-largest source of new power generation in 2005, after new natural gas power plants. In 2005, 2,431 megawatts (MW) of new capacity were installed in 22 states, increasing total wind generating capacity by more than a third to 9,149 MW, or enough to power 2.3 million average American households.

Wind energy is a clean, domestic, renewable resource. It often displaces electricity that would otherwise have been produced by natural gas, thus helping to reduce gas demand and limit gas price hikes (DOE 2006a). It also can serve as a partial replacement for the electricity produced by the aging U.S. coal-fired power plant fleet. In the future, surplus wind power can be used for desalination and hydrogen production, and may be stored as hydrogen for use in fuel cells or gas turbines to generate electricity, leveling supply when winds are variable.

Last February, the President said that wind energy could provide as much as 20% of our electricity demands, up from less than 1% today. Dozens of states have passed renewable portfolio standards setting goals similar to that stated by the President, giving broad-based public support for development of wind resources.

1.1 Wind Energy Facility Description

Wind turbines capture the kinetic energy of the wind and convert it into electricity. Primary components of a wind turbine are the rotor (blade assembly), generator, and tower. Wind spins the rotor, which turns the generator to produce electricity. The generator is mounted at the top of the tower and is enclosed along with the gearbox, controller, and main shaft in the nacelle. Power generated by the turbine is carried to a pad-mounted transformer. At newer turbines, the transformer is at the base of the turbine; at older (smaller) turbines, the power is carried by low-voltage underground cables to a single transformer that services two or three turbines. The transformers increase the voltage from the turbines, and medium-voltage underground cables collect the electricity from the transformers within a wind facility (farm or project) and deliver it to the facility substation. At the substation, the voltage is stepped up further and then integrated into the high-voltage transmission system.

Wind turbines are often sited on land under long term leases from farmers or ranchers in flat, windy regions, where crops are grown and cattle can graze up to the base of the towers. Lease payments increase the incomes of the farmers, with property taxes and other taxes providing financial support for rural county services.

1.2 Sector Economics

According to the American Wind Energy Association (AWEA), the cost of electricity from utility-scale wind systems has dropped by more than 80% over the past 20 years -- from 30 cents to 5 cents per kilowatt-hour (kWh) in some areas (e.g., Class 6 areas) near transmission lines.[1] This compares favorably with energy produced by other sources, as the cost of wind energy is dropping faster than the cost of conventional generation (AWEA 2005). However, recent construction and turbine cost increases due to worldwide increases in steel, copper, and concrete costs, and a shortage of turbines for present worldwide demand may moderate this trend. If environmental costs are included in the calculation of the costs of electricity generation, wind energy's competitiveness would increase because of its low environmental impacts (e.g., no emissions, no environmental costs resulting from mining or drilling, processing, and shipping a fuel.) Key factors influencing the cost of wind energy include the following:

- Larger wind farms provide economies of scale; the larger the wind farm, the lower the cost of energy.
- The energy that the wind contains is a function of the cube of its speed; the higher the wind speed, the lower the cost.
- Wind energy is highly capital-intensive; the lower the construction costs, the lower the energy costs.

The DOE reports that wind technology can operate economically on Class 4 sites with the support of the federal production tax credit, which currently provides a 1.9-cent per kWh tax credit for electricity produced by commercial wind generation plants over the first 10 years of production (DOE 2006b).

2 Wind Energy and the SPCC Rules

2.1 Wind Energy Operations Affected by the SPCC Regulations

Minimal amounts of oil are stored at wind facilities.[2] However two main types of oil-filled electrical equipment of exist at wind farms – turbines and transformers.

Turbines. Oil-filled turbine components include the generator, gearbox, and hydraulic equipment, which are generally housed in the nacelle at the top of the tower. Older turbines contain fewer than 55 gallons in the turbine, but newer ones contain more: A 1.5-MW turbine today contains a total of about 105 gallons of oil in the above components, and a 3.5 MW turbine contains about 260 gallons. The gearbox contains the

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[1] Wind resource classes are defined by average wind power density normalized to a standard height of 33 feet (10 meters) above ground. Class 3 wind resources, with average annual wind speed of 12 miles per hour, are assumed to be marginal for utility-scale wind development. Class 4 resources, with 13 miles per hour average wind speed, are considered good, Class 5 resources have an annual average wind speed of 14 miles per hour and are considered excellent, and Class 6 and higher wind resources, with an annual average wind speed of 15 miles per hour or greater, are considered outstanding (NWTC 2006).

[2] There may be drums of lubricating oil, a drum or tank for used oil that is being collected for recycling, and a small amount of gasoline or diesel fuel for operations (trucks).

greatest portion of the oil – about 80 gallons in a 1.5-MW turbine. The remaining oil (in much smaller quantities) is contained in other turbine components, e.g., generator bearings, brake fluid, and grease for other bearings, all housed in separate components within the nacelle.

Transformers. Like turbines, transformers do not store oil. Rather, they use mineral oil for cooling and insulation to allow the equipment to function. Each pad-mounted transformer may hold up to about 435 gallons of oil. In addition, for each wind project (system, farm, or facility) there is generally one substation that collects the electricity from the individual turbines; these substation transformers are essentially the same as those described in the companion *Draft Assessment of the Potential Costs and Energy Impacts of Spill Prevention, Control, and Countermeasure Requirements for Electric Utility Substations.*

2.2 Wind Energy Operations Not Affected by the SPCC Regulations

Neither the 2002 SPCC rule nor the proposed 2005 amendments cover offshore wind facilities. (The 1973 rule did not cover oil-filled equipment, and there were no offshore wind facilities when the rule was written.) The Department of Interior (DOI) has responsibility for spill prevention and control for offshore facilities. The 2002 SPCC rule acknowledges this in Section 112.1(d)(1)(iii), which refers to the Memorandum of Understanding Among the Secretary of the Interior, Secretary of Transportation, and Administrator of the EPA (MOU) dated November 8, 1993. That MOU notes that Executive Order (E.O.) 12777 (56 FR 54757) delegates to DOI, DOT, and EPA various responsibilities identified in Section 311(j) of the Clean Water Act (CWA). Sections 2(b)(3), 2(d)(3), and 2(e)(3) of E.O. 12777 assigned to DOI spill prevention and control, contingency planning, and equipment inspection activities associated with offshore facilities. Section 311(a)(11) of the CWA defines the term "offshore facility" to include facilities of any kind located in, on, or under navigable waters of the United States. By using this definition, the traditional DOI role of regulating facilities on the Outer Continental Shelf is expanded by E.O. 12777 to include facilities on inland lakes, rivers, streams, and other inland waters.

2.3 SPCC Compliance Requirements for Wind Energy Equipment

The 1973 rules contain no specific mention of substations or other equipment that uses rather than stores oil. Further, there were no wind farms in 1973. The most significant SPCC requirements for wind energy are the secondary containment requirements in the 2002 rule. Under the 2002 rules, all facilities with more than 1,320 gallons (excluding containers with fewer than 55 gallons) that could discharge oil in harmful quantities to navigable waters are subject to the rule. Because most wind farms (but not the individual turbines or pad-mount transformers) meet the 1,320-gallon threshold,[3] all of those that could reasonably be expected to discharge oil in quantities that may be harmful into the navigable waters of the United States would qualify. The 2002 rules require operators to retrofit existing equipment with secondary containment and to install secondary containment for new equipment and substations. The exact number of facilities that would qualify is not known, but as development increases in the northeast and

[3] The oil would be composed of insulating mineral oil lubricating oils.

other areas where navigable waters are abundant, the number of new units requiring secondary containment is likely to increase. Because many wind turbines were constructed before 2002, the need to retrofit could also be significant.

Turbines. Although the turbines contain oil-filled equipment – currently up to about 260 gallons in the various components for the largest turbines – they are designed and located such that any leaks or spills would not result in damage to navigable waters: The turbine is mounted at the top of the tower, which is typically at least 200 feet tall, and it is housed within the nacelle. If oil were to leak from the turbine equipment, turbine low-level and low-pressure fault detection systems would typically limit any oil releases, and the nacelle would contain most if not all of any oil that did leak. If oil were to leak from the nacelle, it would likely flow down the inside of the tower (a hollow metal cylinder) and be contained within that 200-foot-plus-long cylinder. If, instead, the oil leaked out the front of the nacelle, it would likely drip along the outside of the tower. In the rare event that any oil did leak down the outside of the tower, absorbent material is easily placed around the base flange, thereby preventing it from reaching the soil. If it did reach the base, the oil would have become such a minor sludgey mass that it could be scooped up easily with a shovel and disposed of. When a turbine's computer control system shuts the turbine down due to a malfunction, a signal is sent to the wind farm's main control system, which alerts wind farm technicians to investigate the cause of the shutdown and identify any potential leaks. The chances of any of the oil from the turbine reaching a navigable waterway are essentially zero. Because secondary containment is effectively built into the design of the turbines, owners and operators would not be required to implement secondary containment for turbines under the 1973 or 2002 rules or the 2005 amendments.

Transformers. Although a pad-mounted transformer can contain up to 435 gallons of mineral oil, it (like the turbine) is not a storage unit. Rather, pad-mounted transformers are designed, constructed, and maintained according to specifications for their particular operation, with minimal oil throughput. Construction materials are corrosion-resistant, and any leaks are readily detected and remedied. Again, any major pad-mount malfunction or failure is immediately detected by the wind farm computer control system and investigated by windfarm staff. The expected lifespan for pad-mount transformers easily meets or exceeds the 20-30 year planned life of the wind farm. Nevertheless, in areas where there may be a potential for damage due to leakage (e.g., near a waterway or a cliff), the industry takes measures either via secondary containment or nearby emergency spill response equipment to prevent any potential leaks from reaching surface waters. The 2002 rules would mandate secondary containment for all transformers and substations whose locations are such that a discharge of oil could damage navigable waters. The table below presents, for various iterations of the rule, how the rules would affect the pad-mounted and substation transformers used at wind energy facilities.

Application of SPCC Regulations to Transformers at Wind Energy Facilities[a]

	1973 Rule[b]	2002 Rule[c]	2005 Proposed Amendments[d]
Does the SPCC rule apply to wind energy facilities?	No. Wind energy facilities for large-scale electricity production did not exist in 1973. Even if they did, the rule would not apply: § 112.1(b) states that the rule "applies to owners or operators of non-transportation-related onshore and offshore facilities engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, or consuming oil and oil products, and which, due to their location could reasonably be expected to discharge oil in harmful quantities, as defined in Part 110 of this chapter into or upon the navigable waters of the United States or adjoining shorelines." The 1973 rule refers to tanks and containers; it does not refer to equipment that uses oil as being subject to the rule. The closest reference is in the definition of (1) "Non-transportation-related onshore -and offshore facilities," which includes oil production, refining, and storage facilities, pipelines, loading racks, certain vehicles, and "Industrial, commercial, agricultural or public facilities, which use ***and*** store oil, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel." Neither the preamble nor the rule refers to oil-filled, electrical, or any other type of equipment except for equipment associated with oil production and storage or for containment.	Yes. § 112.1(b) states that the rule "applies to any owner or operator of a nontransportation-related onshore or offshore facility engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, ***using***, or consuming oil and oil products, which due to its location, could reasonably be expected to discharge oil in quantities that may be harmful, as described in Part 110 of this chapter, into or upon the navigable waters of the United States or adjoining shorelines."[e] The preamble says that a facility using oil may reasonably be expected to discharge oil and therefore, the prevention of discharges from such facility falls within the scope of the statute. However, EPA distinguishes the bulk storage of oil from the operational use of oil. ''Bulk storage container'' in the 2002 rules mean any container used to store oil. EPA specifically excluded oil-filled electrical, operating, or manufacturing equipment from the definition of bulk storage.	Yes. The amendments make no changes to § 112.1 (b) in the 2002 rule.

	1973 Rule[b]	2002 Rule[c]	2005 Proposed Amendments[d]
Under what category are turbines, transformers, and substations included?	Turbines, transformers, and substations are not included.	"Oil-filled equipment." The rule does not define oil-filled electrical, operating, or manufacturing equipment. However, the preamble states (67 FR 47080) that examples of operating equipment containing oil include electrical equipment such as substations, transformers, capacitors, buried cable equipment, and oil circuit breakers.	"Oil-filled operational equipment." The proposed amendments add a definition for oil-filled operational equipment. "Oil-filled operational equipment" means equipment which includes an oil storage container (or multiple containers) in which the oil is present solely to support the function of the apparatus or the device. Oil-filled operational equipment is not considered a bulk storage container, and does not include oil-filled manufacturing equipment (flow-through process) (70 FR 73550).
What is the minimum amount of oil that must be stored in above-ground containers for the facility to be subject to the rules?	1,320 gallons, in aboveground containers, with no single tank larger than 660 gallons.	1,320 gallons, in aboveground containers (removed single tank threshold). Rule does not apply to equipment with less than 55 gallons.	1,320 gallons for SPCC plan preparation, but no threshold for proposed alternative requirements for secondary containment.
Are ***all*** wind energy turbines, transformers and substations subject to the SPCC rule?	Turbines, transformers, and substations are not included.	Theoretically, no. Only those that store or use more than 1,320 gallons and that due to their location, could reasonably be expected to discharge oil in quantities that may be harmful into or upon the navigable waters of the United States or adjoining shorelines[e] (§112.1(b)). However, because wind energy facilities generally exceed the 1,320-gallon threshold and could be considered to be in a location that meets the navigable water criterion, many or most will, in practice, be subject to the rule.	Same as 2002 rule.

	1973 Rule[b]	2002 Rule[c]	2005 Proposed Amendments[d]
What SPCC regulatory requirement(s) for wind energy turbines, transformers and substations result in energy impacts?	None; SPCC rules do not apply to wind energy turbines, transformers, or substations	Secondary containment for onshore facilities as described in §112.7(c): Owner/operators must "Provide appropriate containment and/or diversionary structures or equipment to prevent a discharge as described in §112.1(b). The entire containment system, including walls and floor, must be capable of containing oil and must be constructed so that any discharge from a primary containment system . . . will not escape the containment system before cleanup occurs.	Secondary containment if implemented, but the new § 112.7(k) offers an alternative for "qualified oil-filled operational equipment." To be qualified, the substation must be at a facility that has had no discharges from "oil-filled operational equipment" in the past 10 years, or, if the facility has not been operational for 10 years, in the years since it has been operational (§ 112.7 (k)(1)). The alternative to general secondary containment is that the owner/operator must: (i) establish and document facility procedures for inspections or monitoring to detect equipment failure and/or a discharge; and (ii) (Unless a response plan under § 112.20 has been submitted) provide an oil spill contingency plan and a written commitment of manpower, equipment, and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful.

[a] The italicizing of certain words in this table has been done by the author for emphasis.
[b] EPA, Oil Pollution Prevention, Non-Transportation-related Onshore and Offshore Facilities, December 11, 1973, 38 FR 34164-34170
[c] EPA, Oil Pollution Prevention and Response; Non-Transportation-related Onshore and Offshore Facilities: Final Rule, July 17, 2002, 67 FR 47041-47152
[d] EPA, Oil Pollution Prevention; Spill Prevention, Control and Countermeasure Plan Requirements – Amendments; Proposed Rule, December 12, 2005, 70 FR 73524-73552
[e] or into or upon the waters of the contiguous zone, or in connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974, or that may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Magnuson Fishery Conservation and Management Act) (§112.1 (b)).

3 Potential for Economic and Energy Supply Impacts from SPCC Requirements at Wind Energy Facilities

It is conceivable that the costs associated with installation and retrofitting of secondary containment for transformers and substations could slow the development and implementation of wind energy in some areas. Also, potential short-term supply disruptions may result when secondary containment is retrofitted to existing transformers, because the transformer must be disconnected from the system during the retrofitting process.

3.1 Costs for Secondary Containment

3.1.2 Costs for Installation of Secondary Containment at New Facilities

Substations. The estimated cost to incorporate secondary containment and design into a new substation is about $100,000. Assuming one substation per wind farm, installing secondary containment would increase capital cost for a new wind facility by $100,000.

Pad-mounted transformers. The average cost to install secondary containment at pad-mounted transformers as they are constructed is expected to be at least $2,500 per transformer depending on containment design, engineering, materials, and soil conditions. Assuming an average of 66 1.5-MW turbines per 100-MW wind farm, installing secondary containment at a new 100-MW facility would increase capital costs by at least $165,000.

Turbines. There are no costs envisioned for installing secondary containment for the oil-filled equipment in the turbines, because they could not reasonably be expected to discharge oil in quantities that may be harmful into the navigable waters of the United States. (If additional secondary containment were required, the industry estimates that construction costs would increase by $25,000 per turbine, excluding costs for additional tower stress and changes to the pad that would be necessitated by the additional weight.)

Total costs for new installation. Based on the above estimates, total costs for installing secondary containment at a new wind facility could be about $265,000. Assuming an average cost of $1 million per MW of installed capacity, installing secondary containment at a new 100-MW facility would increase total costs by about 0.3%. Assuming new construction of about 3,000 MW of installed wind generating capacity per year and average wind farm capacity of 100 MW, about 30 new wind farms could be built per year, requiring nearly $8 million in costs for installing secondary containment at these facilities. (These costs may be higher, as there may in fact be more wind farms with lower per-facility capacities -- particularly in areas where large tracts of land are not available. The costs may also be lower -- as the average turbine size increases, the number of turbines [and transformers] needed per facility would decrease. Also, not all wind facilities may be in locations where a discharge could harm navigable waters.)

Because there are relatively few new wind farms constructed in a given year, the overall costs of installing containment at new substations is not expected to cause significant cost impacts at the national level. However, assuming that the extraordinary growth rates of wind energy development in the past few years will continue for the next several years (until sufficient nonfossil fuel sources come on line to meet demand), these costs could become significant. As the need for energy generated by clean, domestic, renewable fuels increases, it will be important to allocate resources to developing those technologies. In doing so, it will be necessary to balance the need for resources for developing wind technologies that will allow for cost-effective production in low-wind areas with those for providing protections such as secondary containment where there is little if any risk.

3.1.2 Costs for Retrofitting Secondary Containment at Existing Facilities

Substations. The electric utility industry estimates capital costs for retrofitting general containment (e.g., berms, dikes, retaining walls, retention ponds) at existing substations to be $30,000 to $60,000 per facility. The physical area of a given substation, the shell volumetric capacity of the devices within the substation, and overall design (overhead clearances, etc.) in the substation could cause these costs to increase. If "sized" containment is required (e.g., concrete or other containment basins to make it "sufficiently impervious"), these costs will increase. Costs will be higher (about $200,000 per substation) for larger facilities where moving large transformers and repositioning them and removing and replacing extensive overhead bus infrastructure would be required. These estimates do not include the costs of lost power that would result when the substation is taken offline to retrofit the secondary containment, which at a large wind farm, could be more than $100,000 per day (Lemoine 2006).

According to the AWEA website, there are roughly 330 operating wind facilities in the United States. It is not known how many are covered by the 2002 rules or how many have constructed secondary containment around their transformers and substations. However, assuming that the total number of wind farms in a given year is proportional to the installed wind generating capacity in that year, the AWEA data indicate that roughly half of the wind farms existing today were built after 2002 (capacity at the end of 2002 was 4,686 MW; capacity at the end of 2005 was 9,149 MW). Assuming, therefore, that roughly half of the wind farms' substations did not have secondary containment, because they were built prior to the 2002 rule, 165 substations could require retrofitting – if they were all located in areas from which a leak could cause potential harm to a navigable water. The AWEA data also indicate that most of the wind farms built to date are in the west, where the wind speeds are higher and the availability of contiguous land areas is greater. Because western lands also have relatively fewer navigable waters compared with the east, and because some substations may have already installed secondary containment, the number of required retrofits can be assumed to be less than 100% of the total number built before 2002. Assuming one substation for each wind facility build before 2002, that half of these lack secondary containment and are in areas where a leak could lead to potential damage to a navigable waterway, and an average retrofitting cost of $45,000 per substation, the costs to retrofit these 82 substations would be roughly $3.7 million. Again, this estimate does not include the cost of the power sales that would be lost when the substations are taken off line.

Pad-mounted transformers. The costs to retrofit secondary containment at pad-mounted transformers after the initial construction are estimated to be much higher than those for installing secondary containment at the time of initial transformer construction -- at least $5,000 and possibly up to $12,500 per transformer. Engineering costs, labor, heavy equipment costs, materials costs, and lost revenues contribute to the higher retrofitting cost estimates. It is more time-consuming to retrofit existing transformers, and it can be difficult to find contractors that will accept such jobs at often remote sites. Assuming, as above, that 82 facilities would require retrofitting, and that each facility has 66 transformers, the costs to retrofit the 5,412 turbines would be about $27 to 68 million. (Although one transformer serves two to three turbines at the older facilities, where the turbine capacities are smaller, the number of turbines required to generate the same amount of electricity would be greater.)

Turbines. There are no costs envisioned for retrofitting secondary containment for the oil-filled equipment in the turbines, because they could not reasonably be expected to discharge oil in quantities that may be harmful into the navigable waters of the United States. (If such retrofitting were required, the industry estimates that it would cost $50,000 per turbine.)

Total costs for retrofitting. Based on the above estimates, the total costs for retrofitting secondary containment at existing wind facilities are about $31 to 72 million.

The impacts of these costs (both for new installation and for retrofitting) may be greater in areas where the economics for wind energy are less favorable than in others. For example, in New England, there are fewer onshore locations where wind speeds and conditions can provide for cost-effective electricity generation relative to many other parts of the country. Similarly, in areas such as New England, there are more navigable waters per square mile than in many western areas, so the proportion of equipment that would need secondary containment would be higher.

3.2 Potential for Outages during Construction

For safety reasons, the pad-mounted transformer would be electrically disconnected during the installation of secondary containment. The impacts of such disruptions are not known, but a reduction in power output would be expected.

The utility industry estimates that installing secondary containment at an existing substation could require the substation to be removed from service for about two to four weeks. During that time, consumers (and other downstream substations) that would have otherwise been serviced through that substation will need to obtain their electricity from other sources. Technically, this is not a difficult issue. Using alternate feeds is required when substations are down for scheduled maintenance or in cases of unexpected outages due to weather conditions or other overloads. However, removing a substation from service for two to four weeks to install secondary containment could strain the system and exacerbate the supply disruptions that could occur if one or more external events caused outages in the grid. Given that the electricity generated from wind is variable, it is not expected that at this point in U.S. wind energy development that such outages would be significant. Rather, impacts would be expected to be local and of relatively short duration.

Retrofitting could have other unintended consequences that could prolong the outage and exacerbate the strain on the power system. For example, during excavation, cables could be cut that would need to be replaced, or other accidents with similar repercussions could occur. Also, the power that would replace that generated by wind would most likely come from a fossil-fuel plant that produces more emissions than the wind turbine.

The potential for such disruptions and their impacts should be weighed against the benefits of installing secondary containment. These benefits would presumably be to reduce the risks of spills reaching navigable waters, but according to EPA data, the risk of a spill from oil-filled operating equipment is orders of magnitude less than that from a tank (USWAG 2001).

4 Risks

DOE understands that the SPCC rules are only minimally risk-based. If a facility has no potential for discharging oil into navigable waters or adjoining shorelines, it is not subject to regulation under the SPCC program. However, once there is a determination that the facility could discharge any oil into a navigable waterway, it becomes subject to the same prescriptive requirements as a facility with the potential to discharge 100,000 gallons of oil. Wind industry experience has shown though that if any of the oil-containing equipment does leak or fail, it does so in an individual and isolated fashion, so that a significant discharge is not created. DOE believes that the costs and potential energy impacts associated with installing secondary containment at wind energy facilities do not appear to warrant the very small, if any, reduction in risks that they would provide. As noted, because of wind turbine design, leaks or spills from turbines, if they did occur, would not pose a threat to navigable waters. Transformers, and substations are not designed for storage, and they have minimal potential to leak over their designed life span. The cooling, insulating, and lubricating oils in pad-mounted and substation transformers are intrinsic to and facilitate their operation. They are designed, constructed, and maintained according to specifications for their particular operations, they have minimal oil throughput (because frequent transfers of oil are not required), and construction materials are corrosion-resistant. Electrical and operational equipment at wind facilities receive routine inspections and maintenance due to their integral role in the functioning of the electrical generating equipment. In addition, the electrical and operational equipment at wind facilities is essentially self monitored, as a loss of oil would lead to equipment failure and interruption of electrical power generation. The equipment typically has remotely monitored low-oil-level and low-oil-pressure alarms and cutoff switches. These devices serve to protect the equipment and notify operators of equipment problems (e.g., operators must respond and reset alarms). This monitoring system ensures a rapid response to leaks of oil, thereby resulting in an extremely low risk of oil reaching navigable waters. The need for electrical reliability assures prompt detection of a release of oil, enhancing the probability that response actions will be able to prevent a discharge to surface waters.

Money spent to prevent leaks that are unlikely to occur and would be easily mitigated before reaching navigable waters, may be better spent in developing wind energy technologies that can be cost-effective in reducing the nation’s dependence on imported fuels that emit pollutants with known environmental and health effects.

5 Mitigating Options

EPA has announced two mitigating options that would reduce energy impact while providing generally comparable levels of spill prevention and control. One option involves an interpretation of the general containment requirements under the 2002 rules; the second proposes an alternative to the 2002 rules.

5.1 SPCC Interpretive Guidance

In November 2005, EPA published and solicited public comment on *SPCC Guidance for Regional Inspectors* (EPA 2005). This guidance articulated an interpretation of the general containment requirement in 40 CFR §112.7(c) that could significantly reduce the energy impact of the current rules. According to this guidance document,

> "permanent containment structures, such as dikes, may not be feasible (i.e., for certain electrical equipment). Section 112.7(c) allows for the use of certain types of active containment measures (countermeasures or spill response capability), which prevent a discharge to navigable waters or adjoining shorelines. Active containment measures may be deployed either before an activity involving the handling of oil starts, or in reaction to a discharge so long as the active measure is designed to prevent an oil spill from reaching navigable water or adjoining shorelines. Passive measures are permanent installations and do not require deployment or action by the owner/operator." (EPA 2005)

One example of an active measure particularly relevant to substations described in the guidance document is the use of spill response capability (spill response teams) in the event of an oil discharge.

> "This method differs from activating an oil spill contingency plan (such as required in §112.7(d)), because the response actions are specifically designed to contain an oil discharge prior to reaching navigable waters or adjoining shorelines. This may include the emergency construction/deployment of dikes, curbing, diversionary structures, ponds, and other temporary containment methods (such as sorbent materials) as long as they can be implemented in time to prevent the spilled oil from reaching navigable waters or adjoining shorelines." EPA refers to this type of active measure as "land-based response capability."

The critical point regarding this option is the speed of implementation. Although EPA acknowledges that "it may be impractical to pre-deploy" measures such as the use of sorbent materials, the effectiveness of this option requires prompt detection of a release of oil, and the active measure must be implemented in a timely manner to prevent the oil from reaching navigable waters or adjoining shorelines. For facilities in a position to rely on land-based response capability, the mitigation of energy impact from the assumption that only passive containment measures are acceptable can be significant. The attractiveness of this option is that it constitutes compliance with the general containment requirements of §112.7(c) and does not require the development of a Part 109 contingency plan. But as EPA has correctly observed, "permanent (passive) containment structures . . . may not always be feasible."

Because guidance is not binding and is often subject to interpretation, this option could be made explicit in the actual rule.

5.2 Regulatory Amendments

EPA has proposed an alternative to the 2002 rules that would reduce energy impact, while providing the same level of spill prevention and control. If the proposed revisions as detailed in the December 2005 proposed amendments were implemented as written, they would provide a rational balance between achieving the SPCC objectives and those of increasing wind energy development in a cost-effective manner over the next few years.

Other mitigating options include the following:

- Exempt electrical and operating equipment in wind turbines and pad-mounted transformers from some of the provisions of the SPCC rule because of the small quantities of oil stored in these units, the exceptionally low risk of oil release into navigable waters, and the essentially spill-free history associated with this type of equipment. This option could explicitly require the installation of secondary containment for new substation transformers in locations with the potential to harm navigable waters should a discharge occur, and requirements for spill response materials, staff training, and spill response procedures for wind farms where total quantities exceed the 1,320 gallon limit.

- If regulations are deemed necessary for oil in electrical and operating equipment at wind generation sites, create a volumetric threshold where each generator (turbine including its pad-mounted transformer) would be classified as a separate facility thereby exempting generators containing less than 1,320 gallons from the requirements of the SPCC rule.

- Allow consideration of manmade features integral to the operations of the facility or indistinguishable from natural topography that also serve to prevent discharges in determining whether a facility could reasonably be expected to discharge to navigable waters.

- Require secondary containment at pad-mount transformers only where they are particularly close to water bodies and there is significant risk of oil reaching the water body in the case of a transformer leak.

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